OBSERVATIONS ON A POPULATION OF *SIALIS ITASCA* ROSS IN WEST VIRGINIA (MEGALOPTERA: SIALIDAE)

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Observations on the ecology of each species in an aquatic community are necessary for the total understanding of community dynamics. Several authors, including Davis (1903), Ross (1937), Townsend (1939), Flint (1964), Azam and Anderson (1967), Woodrum and Tarter (1973), Pritchard and Leischner (1973), Tarter and Woodrum (1973), Tarter (1973), Tarter et al. (1976), and Tarter et al. (1978) have reported on the taxonomy, distribution, life history, and ecology of several *Sialis* spp. Other authors, including Roback and Richardson (1969), Warner (1971), Nichols and Bulow (1973), Tarter and Woodrum (1972) and Woodrum and Tarter (1973), have noted the extreme tolerance of *Sialis* to acid mine drainage.

The primary objectives of this investigation were: (1) to make observations on the life history and ecology of the alderfly *S. itasca* in a small farm pond and (2) to determine the pH tolerance of this population under laboratory conditions.

Materials and Methods

The population of *S. itasca* inhabits a small farm pond, 0.1 hectare, near Shoals, West Virginia which is 8 km south of Huntington, West Virginia. This pond is located in the north-central region of Wayne County. It is located at 82°29′40″W longitude and 38°21′50″N latitude.

This investigation was initiated in May 1975 and continued until April 1976. Monthly samples were taken by a small seine (0.25 inch mesh). The seine was placed in the water vertically and the mud and debris on the bottom of the pond between the seine and the bank were disturbed. The seine was then moved toward the bank while dragging the bottom of the net on the bottom of the pond collecting

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mud and debris in the net. The larval alderflies were collected and preserved in 70 percent ethanol.

Temperatures were taken with a Taylor maximum-minimum thermometer placed on the pond bottom 0.5 meter below the water surface. They were recorded in degrees Celsius once per month at the time benthic samples were taken. Water chemistry tests were performed in the field with a Hach chemical kit, Model AL-36-WR. All tests were completed within one hour. Hydrogen-ion concentration (pH) was measured colorimetrically. Dissolved oxygen, carbon dioxide, hardness (magnesium and calcium), phenolphthalein and methyl orange alkalinity, free acidity, and total acidity were measured and recorded in mg/l.

Size classes were determined by length frequency distributions arranged in 1 mm length groups. Total length (exclusive of the caudal filament) was measured under 7× magnification with calipers and a plastic ruler (nearest 0.5 mm). Head width was measured with an ocular micrometer between the inner edges of the eyes (nearest 0.01 mm). Differences in head width of 124 larvae were determined to show the mean, range and standard deviation.

A total of 84 foreguts were examined to determine food habits. The head was removed and the abdomen was split open to remove the intestine. The contents of the intestine were removed and examined under a dissecting microscope and a compound microscope to identify their contents. The percent frequency of occurrence of each item was determined, and the monthly and seasonal averages and various sizes were compared.

For the pH tolerance test, forty mature larvae collected from the pond in April were taken to the laboratory for acclimatization over a 24 hr period. The larvae were placed in groups of 10 in 4 finger bowls. One bowl was filled one-third of the way with pond water. A one molar solution of potassium dihydrogen phosphate (KH_2PO_4) was diluted approximately into the other three bowls, to set pH values at 5.5, 4.0, and 2.5. The pH value of the control was 7.0. A Model 5 Corning Scientific pH meter was used to determine pH values. Oxygen was constantly supplied with air stones. The temperature did not change significantly during the experiment and averaged 12 C. The 96 hour TL_m (median tolerance limit) test (APHA, 1965) was used to measure the effect of low pH. The pH value at which 50 percent of the alderfly larvae died after 96 hours was determined by straight-line graphical interpolation.

Fifteen larvae were collected in April and returned to the laboratory for rearing in vials containing pond water. These vials were connected to vials containing sand by a short section of rubber tubing (Pritchard and Leischner, 1973). Wire mesh and strips of foam rubber were placed in the vials and rubber tubing to enable the larvae (one per vial) to move freely between the vials. The vials were kept at room temperature which was approximately 70 F.

Fecundity was determined by a direct count of ovarian eggs under a compound microscope. The ovaries of 3 adults were removed and a total of 1616 eggs were counted. The diameters of 90 eggs were measured to the nearest 0.01 mm with an ocular micrometer using a Bausch and Lomb compound microscope.

Results and Discussion

Pond Environment

Temperature. — The average annual temperature for the pond was 18.1 C. The extreme monthly temperatures were 0.5 C in February and 35.0 C in August and September.

Water Chemistry. — The average annual pH was 8.4 (7.5 to 9.0). The average annual dissolved oxygen was 8.5 mg/l (6.5 to 10.0). The average annual total hardness was 139.6 mg/l (102.6 to 153.9). The average annual carbon dioxide concentration was 9.6 mg/l (5.0 to 25.0). The average annual alkalinity was 110.5 mg/l (68.4 to 145.4). The average annual total acidity was 12.4 mg/l (5.7 to 28.5).

Larval Stage

Development. — Length-frequency histograms indicated that the population of *S. itasca* contained one size class (Fig. 1). Hatching occurred at the end of May. There were 18 egg masses located in the field at the end of May. The egg masses were found on the leaves of hornbeam and buckeye trees. Three egg masses which were returned to the laboratory hatched within 2 days. In July all the egg masses were empty but no larvae were located. The earliest and smallest larvae were collected on August 2, 1975. Their average length was 6.45 mm, and their average head width was 1.02 mm. The last and largest larvae were collected on April 6, 1976. Their average length was 13.67 mm, and average head width was 1.59 mm.

Head width was used to show the monthly variation in growth rate and the percent increase in growth rate (Fig. 2). Due to the

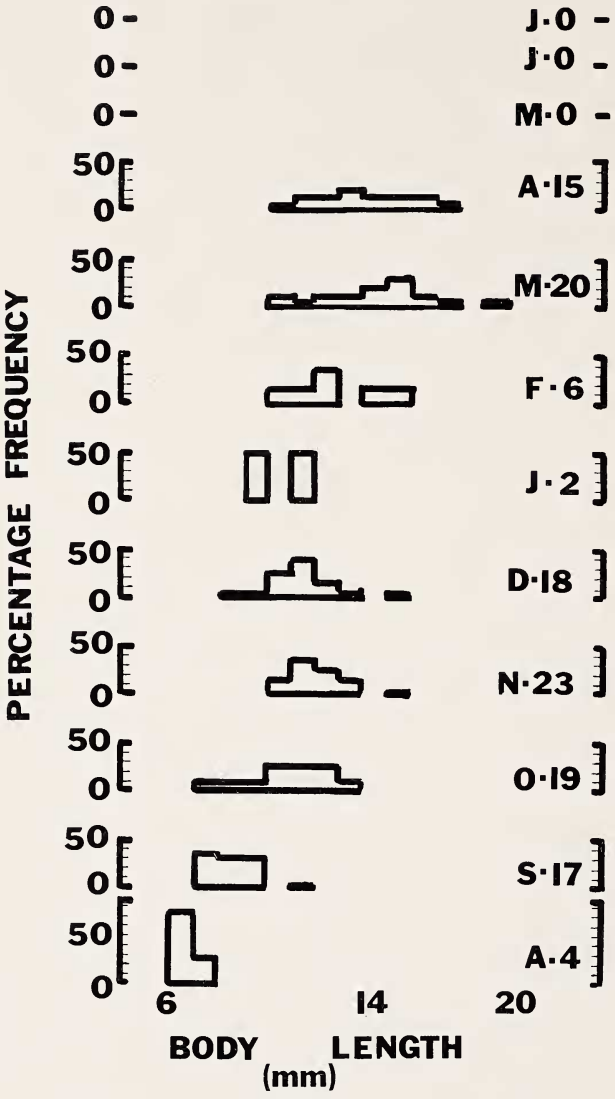

Figure 1. Length-frequencies at monthly intervals of *S. itasca* larvae from a farm pond near Shoals, W. Va. The number of larvae is given for each month.

small sample size (4) in August, no statement can be made concerning the growth rate from August to September. An eighteen percent increase in growth rate was recorded from October to November. There was a decrease in growth rate in December. Small sample sizes in January (2) and February (6) prevented any growth rate information. There was a six percent growth rate from March to April. The largest mean head width was measured in April at 1.59 mm and ranged between 0.95 and 1.86 mm September and November, respectively. No larvae were located in May, June and July.

Woodrum and Tarter (1973) also found a decrease in growth during the winter months in *S. aequalis*. Azam and Anderson (1969) found a decrease in the growth rate for *S. rotunda* and *S. californica* during the winter months.

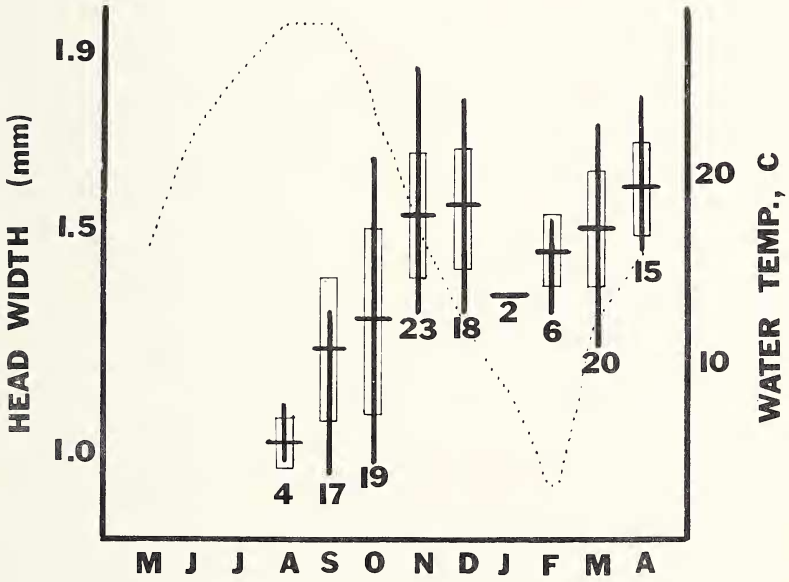

Figure 2. Monthly variation of the head width in *S. itasca* larvae. Vertical lines = ranges, horizontal lines = means, open rectangle = one standard deviation, numbers = sample sizes, and dotted lines = temperature (C).

Food Habits. — This population of *S. itasca* was found to feed almost exclusively on the ostracod, *Cyclocypris* sp. The only other food items were 3 midges, *Chironomus* sp., which were found on 3 different occasions. Of the 84 foreguts analyzed, 21 percent were empty and 79 percent contained food. Ostrocods were found in 71 percent of the foreguts, and midges were found in 4 percent of the foreguts.

Excluding the month of August when a very small sample size (4) was used, the largest number of empty foreguts occurred in January (50%). The percent of empty foreguts increased again in April supporting the findings of Woodrum and Tarter (1973) in *S. aequalis* that the larvae probably do not feed just before pupation.

Azam and Anderson (1969) reported *S. rotunda* and *S. californica* to be indiscriminate feeders and reported cannibalism to be frequent. Woodrum and Tarter (1973) found *S. aequalis* to be more restricted in its feeding due to the limited choices of organisms found in the acid mine stream in which they were located. They also reported cannibalism to occur to a lesser extent. The *S. itasca* in this investigation were found to be more restrictive feeders preying almost exclusively on ostracods while having an abundant supply of other organisms upon which they could feed. Cannibalism was observed in the laboratory when larvae were confined for three days without food.

Predation. — The stomachs of 18 odonates and 10 sunfish were examined. No alderfly remains were found in the sunfish and only one alderfly head was found in the odonates. Schwiebert (1973) noted that the hellgrammite and trout are predators of the alderfly.

pH Tolerance. — The 96 hour TL_m value for *S. itasca* was found to be 3.1. All ten larvae survived the 96-hour period at pH values of 7.0 and 5.5, 70 percent survived in a pH of 4.0, and 30 percent survived at a pH of 2.5. Tarter and Woodrum (1972) found *S. aequalis* from an acid mine stream to have a TL_m value of 2.1. These values would indicate that *S. itasca* and *S. aequalis* are quite tolerant of low pH. *Sialis* spp. have been noted to be tolerant to low pH conditions in western Pennsylvania streams (Roback and Richardson, 1969), Roaring Creek in eastern West Virginia (Warner, 1971), and in the East Fork of the Obey River in Tennessee (Nichols and Bulow, 1973).

Pupal Stage

Larvae placed in the laboratory rearing chambers moved to the sand for pupation within 2 to 4 days. The pupal stage lasted for approximately 2 weeks. The adults emerged during the night. No pupae could be located in the bank of the pond.

Azam and Anderson (1969) reported *S. rotunda* and *S. californica* to pupate during April, May and June. Pritchard and Leischner (1973) reported that *S. cornuta* pupated from May to mid-June. Woodrum and Tarter (1973) found *S. aequalis* to crawl 1.5 to 5 m out of the water onto a moist sandbank when the water temperature reached 11 to 13 C and pupated in an earthen cell 1 to 7 cm below the surface. They found the pupae to respond to a disturbance but otherwise remained rather dormant.

Adult Stage

Number and Size of Eggs. — Fecundity of 3 adult alderflies showed a range of 454 to 587 eggs per female; the average was 539 eggs. The eggs were cylindrical, rounded on the ends, had a curved micropylar tubercle on one end, and averaged 0.31 mm in length by 0.14 mm in width. The number of eggs found in *S. itasca* was similar to those of *S. aequalis* (657) (Woodrum and Tarter, 1973), *S. rotunda* (300–500) and *S. californica* (400–700) (Azam and Anderson, 1969), and *S. cornuta* (615) (Pritchard and Leischner, 1973). Egg masses of *S. itasca* were found on the underside of hornbeam and buckeye leaves 0.5 to 3 m above the water surface. The eggs are laid in rows in a nearly vertical position much like those of *S. rotunda* (Azam and Anderson, 1969).

Mating. — Although copulation was not observed, a courtship behavior was observed in the laboratory much like that described by Azam and Anderson (1969) for *S. rotunda* and by Woodrum and Tarter (1973) for *S. aequalis.*

Longevity. — Adults in the laboratory lived for 4 to 6 days. Only one adult was captured in the field on 3 May 1975. *Sialis rotunda* was first seen in mid-April and reached their peak in May (Azam and Anderson, 1969) while *S. californica* was seen in May but did not peak until mid-June (Azam and Anderson, 1969). *Sialis aequalis* was observed in the field between April 21 and May 4 (Woodrum

and Tarter, 1973). Since the adults serve only to reproduce the species, it is apparent that they have a brief life span to perform this function. Azam and Anderson (1969) observed the female of *S. rotunda* laying eggs within a day after emerging.

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